EVOLUTION OF THE CHAROPHYTE FLORAS IN THE UPPER EOCENE AND LOWER OLIGOCENE OF THE ISLE OF WIGHT

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ABSTRACT. The distribution of charophyte gyrogonites in the Headon, Osborne, and Bembridge Beds is analysed. The flora, including a new species, *Nitellopsis* (*Tectochara*) *latispira*, is described. It is considered that transitional forms in the genera *Psilochara* and *Harrisichara* constitute examples of evolution in Palaeogene genera. The stratigraphical importance of *Sphaerochara subglobosa* (Groves) Horn af Rantzien, which extends from the Upper Headon to the Lower Hamstead Beds, is discussed. It is confirmed that the position of the Eocene–Oligocene boundary that most closely agrees with the charophyte distribution is that situated at the Middle Headon Beds.

THE Hampshire basin Palaeogene charophytes, which were described by Reid and Groves (1921), Groves (1926), and Grambast (1958), are of considerable stratigraphic importance, as the Hordle and the Bembridge floras form the basis of two charophyte zones (Castel 1968; Grambast 1972). The charophyte Verzenay (Hordle) Zone, which includes the mammal Euzet Zone (Feist-Castel 1971), is the highest presently defined in the Eocene. The Bembridge Zone, whose type-locality is the same age as Montmartre in the Paris basin (Stehlin 1909), corresponds to the Early Oligocene (Lattorfian) and to the base of the Middle Oligocene.

The Eocene–Oligocene boundary is taken as the base of the Middle Headon Beds, as suggested by Curry (1958). In order to establish the floristic evolution at the Eocene–Oligocene boundary, specimens were collected from the transitional series between the Lower Headon and Bembridge Beds in the Isle of Wight. Graduated samplings from the Middle and Upper Headon Beds, as well as from the Osborne Beds, proved to be very rich in specimens. The floras studied here came primarily from personal collecting. Samples found by Professor D. Curry were also studied.

LOCATION OF SAMPLES AND CHAROPHYTE DISTRIBUTION

The localities are well-documented cliff-sections on the western and eastern coasts of the Isle of Wight. Their position in the series is defined by the stratigraphic succession generally accepted since the work of Forbes (1856) and described in greater detail later (Bristow 1862; White 1921; Curry 1968).

Table 1 showing the sampling localities, is followed by a description of that part of the succession from which samples were taken, and which includes lists of charophyte species found.

[Palaeontology, Vol. 20, Part 1, 1977, pp. 143–157, pls. 21–22.]

TABLE 1. Distribution of charophyte localities in the Upper Eocene and Lower Oligocene succession of the Isle of Wight.

Localities / Beds	Headon Hill	Cliff End	Horestone Point	Whitecliff Bay
BEMBRIDGE			●	● ●
OSBORNE		● ●		●
UPPER HEADON	● ●	●		
MIDDLE HEADON	●			
LOWER HEADON	●			

HEADON HILL (National Grid reference SZ 305 860)

(*a*) *Lower Headon Beds*. Only one sample was collected, 1 m above the white Barton sands.

Cream-coloured calcareous marls with shells (40 cm): *Psilochara polita*, *P. bi-truncata* (scarce), *Stephanochara edwardsi*, *Grovesichara distorta*, *Harrisichara vasiformis*, *H. vasiformis-tuberculata*.

All these species occur within the Lower Headon Beds at Hordle, the flora of which was described by Reid and Groves (1921).

(*b*) *Middle Headon Beds*. Lower part; brackish clays with lignite ('*Neritina* beds'): *Gyrogona wrighti*, *Grambastichara tornata*, *Chara antennata* (scarce).

The upper part, the marine 'Venus beds' and blue clays, did not yield any charophytes.

(*c*) *Upper Headon Beds*. Samples were collected from two stratigraphical positions in these beds:

(i) Approximately 3 m above the Middle Headon blue clays, cream-coloured marls with shells: *Gyrogona wrighti*, *Harrisichara vasiformis-tuberculata*, *Grovesichara distorta*.

(ii) 3 m above the latter, cream-coloured calcareous clays with shells: *Gyrogona wrighti*, *Sphaerochara subglobosa*, *Harrisichara vasiformis-tuberculata*.

In these Upper Headon Beds, Professor D. Curry collected charophyte gyrogonites which have been determined by the writer to be: *Gyrogona wrighti*, *Grovesichara distorta*, *Chara antennata*, *Psilochara* sp., *Harrisichara* sp. (scarce).

CLIFF END (National Grid reference SZ 331 891)

(*a*) *Upper Headon Beds*. Cream-coloured marls lying above the Middle Headon Beds: *Grovesichara distorta*, *Harrisichara vasiformis-tuberculata*, *Psilochara* aff. *bitruncata*, *Sphaerochara subglobosa*.

This locality also revealed an insectivore mammal tooth, cf. *Spalacodon*, identified by Dr. B. Sigé.

(*b*) *Osborne Beds*. Samples were collected from two stratigraphical positions in these beds:

(i) About 30 m above the Upper Headon Beds, calcareous marls with ferruginous concretions: *Nitellopsis* (*Tectochara*) aff. *aenula*, *Harrisichara vasiformis-tuberculata*, *Psilochara* aff. *bitruncata*, *Sphaerochara subglobosa*.

With this flora was found a rodent tooth identified by Dr. M. Vianey-Liaud as *Theridomys* (*Theridomys*) *pseudosiderolithicus* De Bonis, closely resembling that from La Debruge.

(ii) Approximately 10 m above the ironstone band, multicoloured clays with concretions of argillaceous limestone: *Gyrogona wrighti*, *Harrisichara vasiformis-tuberculata*, *Psilochara* aff. *bitruncata*.

HORESTONE POINT (National Grid reference SZ 634 907)

Bembridge Limestone. About 1 m above the beach level: brown, then black, marls, topped by a limestone.

(i) Brown marls: *Harrisichara tuberculata*, *Nitellopsis* (*Tectochara*) *latispira*, *Gyrogona wrighti*, *Grovesichara distorta*, *Rhabdochara stockmansi* (scarce).

(ii) Black marls: *Harrisichara tuberculata*.

WHITECLIFF BAY (National Grid reference SZ 642 863)

(*a*) *Osborne Beds*. Yellow limestone with charophytes, topped by green marls containing: *Gyrogona wrighti*, *Harrisichara vasiformis-tuberculata*, *Sphaerochara* sp. (scarce), *Chara* sp.

(*b*) *Bembridge Limestone*—lower part.

(i) Pale-brown clayey limestone: *Harrisichara tuberculata*.

(ii) Superposed to the latter, black marls: *Harrisichara tuberculata*, *Sphaerochara subglobosa*.

Material found by Professor D. Curry in the Bembridge Limestone has been found to be: *Harrisichara tuberculata*, *Rhabdochara stockmansi*, *Gyrogona wrighti*, *G. caelata*.

SYSTEMATIC DESCRIPTIONS

Family CHARACEAE L. Cl. Richard, 1815

Genus GYROGONA Lamarck, 1904 ex Lamarck, 1822 emend. Grambast, 1956

Gyrogona wrighti (Salter ex Reid and Groves) Pia, 1927

1856 *Chara wrighti* Salter *in* Forbes, p. 160, pl. 7, figs. 15–21.

1921 *Chara wrighti* Salter ex Reid and Groves, p. 183, pl. 4, fig. 1.

1927 *Gyrogonites wrighti* Pia, p. 90.
1954 *Aclistochara wrighti*, L. and N. Grambast, p. 59, fig. 1.
1954 *Brachychara wrighti*, L. and N. Grambast, p. 667.
1956 *Brevichara hordlensis* Horn af Rantzien, p. 245.
1957 *Gyrogona hordlensis*, Grambast, p. 280.
1958 *Gyrogona wrighti*, Grambast, p. 145.

Syntypes. Specimen nos. 74500, 76499, Geological Survey, London.

G. wrighti occurs in most of our localities (see Table 2). It is particularly abundant in the limestones, and in the brackish facies such as the Middle Headon *Neritina* Bed at Headon Hill. Gyrogonites from the same locality present quite notable morphological differences: the shape may be more or less subglobular (length/width ratio varying from 0·9 to 1·0), the spiral cells and apical nodules are faintly prominent, the size varying between broad limits (length 750–1100 μm, width 750–1125 μm). These differences, however, are within the limits of the species.

G. wrighti, known from the Bartonian (Calcaire de Saint-Ouen, Grambast 1972) to the Lower Oligocene, is of no stratigraphic use in this study.

Genus GROVESICHARA Horn af Rantzien, 1959

Grovesichara distorta (Reid and Groves) Horn af Rantzien

Plate 21, fig. 7

1921 *Chara distorta* Reid and Groves, p. 186, pl. 5, fig. 6.
1959 *Grovesichara distorta*, Horn af Rantzien, p. 125, pl. 15, figs. 1–7.
1959 *Grovesichara distorta*, Grambast, p. 8, fig. 2.

Lectotype. Reid and Groves 1921, pl. 5, fig. 6. Lowermost right-hand specimen (designated by Horn af Rantzien 1959). The type-material was found by Grambast (1958) to be at the British Museum and not in the collections of the Geological Survey.

This well-known species is easily recognizable by its massive and somewhat irregular shape and by its apex, where the thick and straightened cellular ends form a very convex cap. The basal plug is visible somewhat below the pore. Besides Hampshire, *G. distorta* has been reported from the Auversian and Bartonian by Grambast (1958, 1962) as well as from the Lower Oligocene by Riveline (1973). In the Isle of Wight, it occurs in the Upper and Lower Headon Beds, the latter being its type-stratum. Depending on the localities, variations occur in the length/width ratio of the gyrogonites. Thus, in the Lower Headon Beds at Headon Hill, this ratio is between 1·1 and 1·3, whereas in the Upper Headon Beds at Cliff End it is not far from 1·0, the general shape being more globular. The specimens gathered in the Upper Headon Beds at Headon Hill were not sufficiently abundant for population studies.

Genus NITELLOPSIS Hy, 1889

Sub-genus TECTOCHARA L. and N. Grambast, 1954

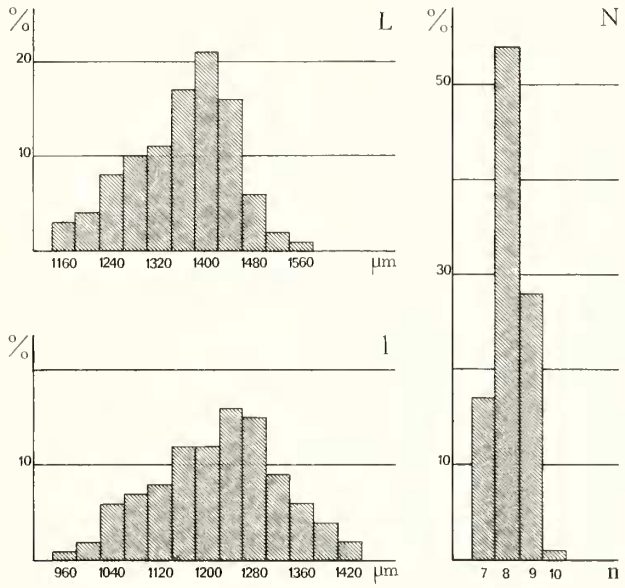
Nitellopsis (*Tectochara*) aff. *aemula* Grambast, 1972

Plate 22, fig. 4*a–c*

1972 *Tectochara meriani* L. and N. Grambast, 1954 ssp. *aemula* Grambast, p. 23, fig. 10, pl. 8, figs. 1–6.
1972 *Nitellopsis* (*Tectochara*) *aemula* (Grambast) Grambast and Soulié, p. 11.

Holotype. Specimen no. V 41 126, British Museum (Natural History), London.

This form occurs in the ironstone band of the Osborne Beds, at Cliff End. It is here considered as allied to *N.* (*T.*) *aemula* of the Lower Hamstead Beds, but it is not impossible that it might be hereafter attributed to a new and distinct species. Characters common to both are the ovoid shape with a thin basal region, the similar dimensions, and the basal pore of small diameter. The form from Cliff End differs from *N.* (*T.*) *aemula* by its somewhat longer general shape, the less prominent base, the less marked basal funnel, and the basal plug which is relatively thick for a *Tectochara*.



TEXT-FIG. 1. *Nitellopsis* (*Tectochara*) *latispira* n. sp. Histograms showing the variation in gyrogonite length (L), width (l), and number of convolutions (N). One hundred specimens measured.

Nitellopsis (*Tectochara*) *latispira* n. sp.

Plate 22, fig. 3*a–d*

Holotype. Specimen no. C.F. 1584-1; Université des Sciences et Techniques, Montpellier, France.

Paratypes. Specimen nos. C.F. 1584-2 to 1584-5; Université des Sciences et Techniques, Montpellier, France.

Type-locality and horizon. Horestone Point, Isle of Wight (SZ 634 907); brown marls at the base of Bembridge Limestone.

Material. About 500 specimens.

Diagnosis. Gyrogonite subglobular to ovoid, apex truncated or slightly convex, basal region thin, protruding, and truncated. Cells somewhat thinner and narrower at periphery of apex; apical ends of cells gradually widening, usually with only slightly prominent nodules. Basal ends entirely calcified and delimiting a wide basal funnel. Pore small, measuring 50–80 μm; relatively thick plug of 170–280 μm in diameter and 130–180 μm in thickness.

Dimensions. 1160–1560 μm, often 1360–1440 μm long; 960–1420 μm, often 1140–1280 μm wide; length/width ratio: 0·98–1·30; 7–10 convolutions. Cells smooth, flat to slightly convex, 160–260 μm high.

Affinity. This new species agrees with the genus *Nitellopsis* in the general shape of its gyrogonites, more often higher than wide, in the shape of the periapical region where the cells become thinner and narrower, and in the apical nodules which, however, are not very prominent. The thin base and well-developed basal funnel are characteristic of the subgenus *Tectochara*. Among the known species, the subglobular shape and narrow base of *N.* (*T.*) *latispira* recalls *N.* (*T.*) *supraplana* (Peck and Recker) Grambast and Soulié from the Eocene of Peru, but differs by its greater dimensions, especially in length. The shape and the base of this new species is also suggestive of *N.* (*T.*) *aemula* (Grambast) Grambast and Soulié, from the Lower Hamstead Beds of Isle of Wight, but differs by the less protruding base, which in the latter is emphasized by depressions in front of the basal ends of the cells. The gyrogonite is also more globular in *N.* (*T.*) *latispira*, the cell width and height of the plug are greater, and there is one less convolution of the spiral cells.

Genus SPHAEROCHARA Mädler, 1952 emend. Horn af Rantzien and Grambast, 1962

Sphaerochara subglobosa (Groves) Horn af Rantzien, 1959

Plate 21, figs. 8, 9

1926 *Chara subglobosa* Groves, p. 172, pl. 12, fig. 3.
1959 *Sphaerochara subglobosa*, Horn af Rantzien, p. 129.

Syntype. Specimen no. V. 18331, British Museum (Natural History), London.

Identification. Grove's species had not, until now, been rediscovered, or perhaps not recognized, because of the inadequacy of the original illustration. Despite Grove's very complete diagnosis, only a thorough examination of the type-material allowed us to ascribe to this species some *Sphaerochara* from the Isle of Wight, as well as some other specimens previously collected in the Lower Oligocene of the south of France.

Description. Gyrogonite subglobular to broadly ellipsoid; apex convex, base truncated. Spiral cells with granulose surface, ornamented with massive nodules, as high as the cells, generally laterally elongated, disappearing at the periphery of the apex. Apical ends of the cells bulging, forming a rosette where the thickness of the

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EXPLANATION OF PLATE 21

Fig. 1. *Harrisichara vasiformis* (Reid and Groves) Grambast, lateral view, ×60; from Lower Headon Beds, Headon Hill.

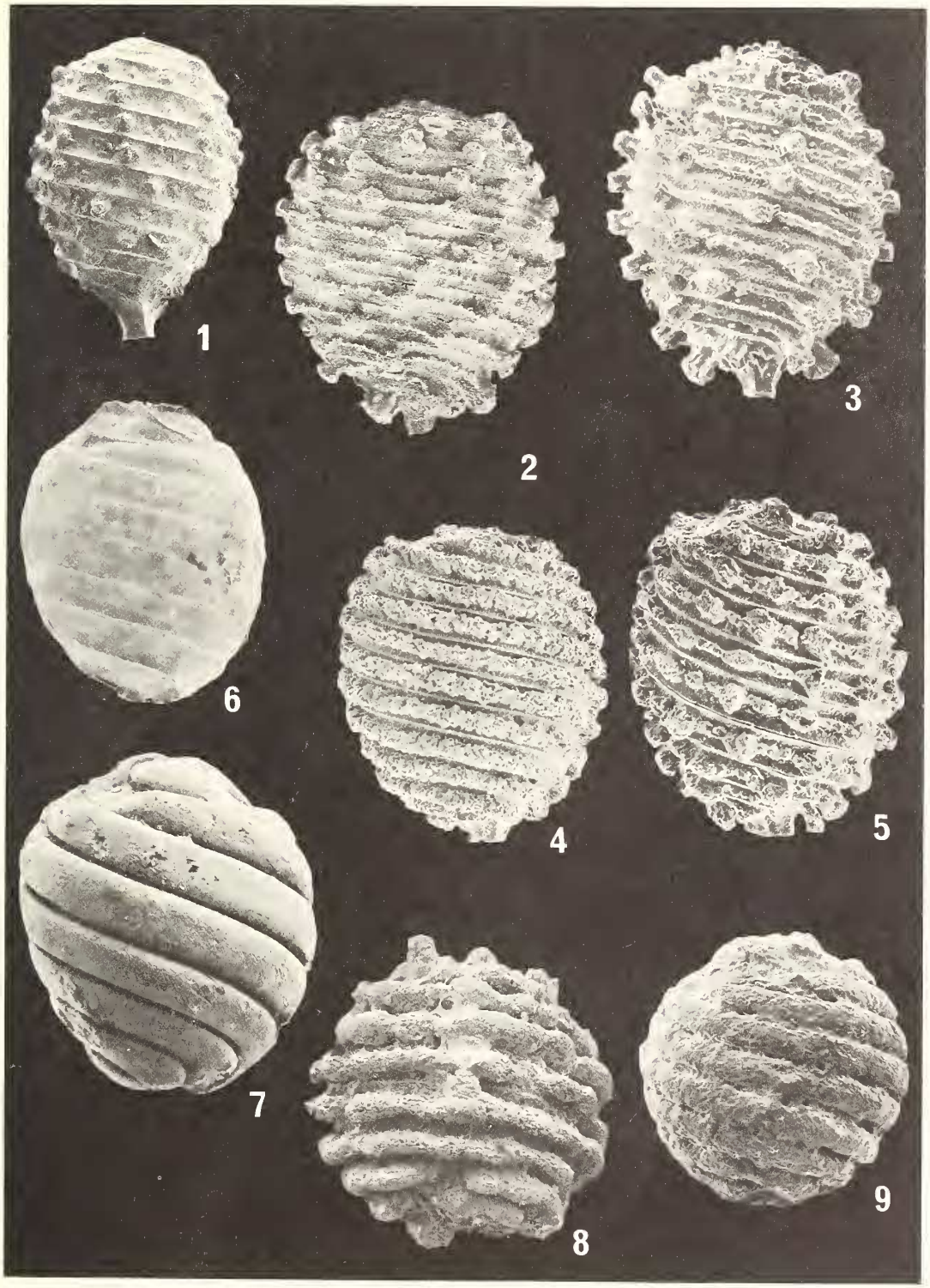
Figs. 2–3. *Harrisichara vasiformis-tuberculata*, lateral view, ×60; from Upper Headon Beds; 2, from Headon Hill; 3, from Cliff End.

Figs. 4–5. *Harrisichara tuberculata* (Lyell) Grambast, lateral view, ×50; from Bembridge Beds; 4, from Horestone Point; 5, neotype, from Whitecliff Bay.

Fig. 6. *Psilochara* aff. *conspicua* Grambast, lateral view, ×50; from Upper Headon Beds, Cliff End.

Fig. 7. *Grovesichara distorta* (Reid and Groves) Horn af Rantzien, lateral view, ×45; from Lower Headon Beds, Headon Hill.

Figs. 8–9. *Sphaerochara subglobosa* (Groves) Horn af Rantzien, lateral views, ×90; 8, from Upper Headon Beds, Cliff End; 9, from Osborne Beds, Whitecliff Bay.



FEIST-CASTEL, Charophytes from the Isle of Wight

cells increases again, thus forming nodules similar to the lateral ones; apical nodules sometimes undeveloped. Basal plug level with the pore, surrounded by a crown of nodules.

Dimensions. 350–500 μm long, 350–475 μm broad, spiral cells 50–65 μm wide, showing 6–9 convolutions.

Relationships. This species clearly corresponds with the genus *Sphaerochara* in its general globose shape, its small size, the prominent apical rosette, and the basal plug level with the pore. It differs from other known species of the genus in its ornamentation.

Stratigraphic significance. In the Isle of Wight, *S. subglobosa* occurs in several localities in the Upper Headon, Osborne, and Bembridge Beds. According to Groves, it persists into the Lower Hamstead Beds; it does not seem to occur below the Upper Headon Beds. *S. subglobosa* is thus the only species which makes its appearance between the Lower Headon and Bembridge Beds, other taxa present being persistent Eocene or intermediate Eocene–Oligocene forms.

Genus HARRISICHARA Grambast, 1957

Harrisichara vasiformis (Reid and Groves) Grambast, 1957

Plate 21, fig. 1

1921 *Chara vasiformis* Reid and Groves, p. 185, pl. 4, figs. 12–15.
1927 *Kosmogyra vasiformis*, Pia, p. 90.
1957 *Harrisichara vasiformis*, Grambast, p. 347, pl. 6, fig. 4.

Lectotype. Specimen no. 76528, Geological Survey, London. Designated and refigured by Grambast (1957).

The Lower Headon Beds (Upper Bartonian) are characterized by typical specimens of *H. vasiformis* recognizable by their narrow base and rounded apex. The same typical aspect is shown by populations of *H. vasiformis* in beds of the same age in the south of France, in the Alès basin for example (Feist-Castel 1971). However, at Headon Hill and at the type-locality at Hordle (Hampshire mainland) specimens are found of similar size but which have a more rounded base and more flattened apex, a shape which is suggestive of *H. tuberculata*.

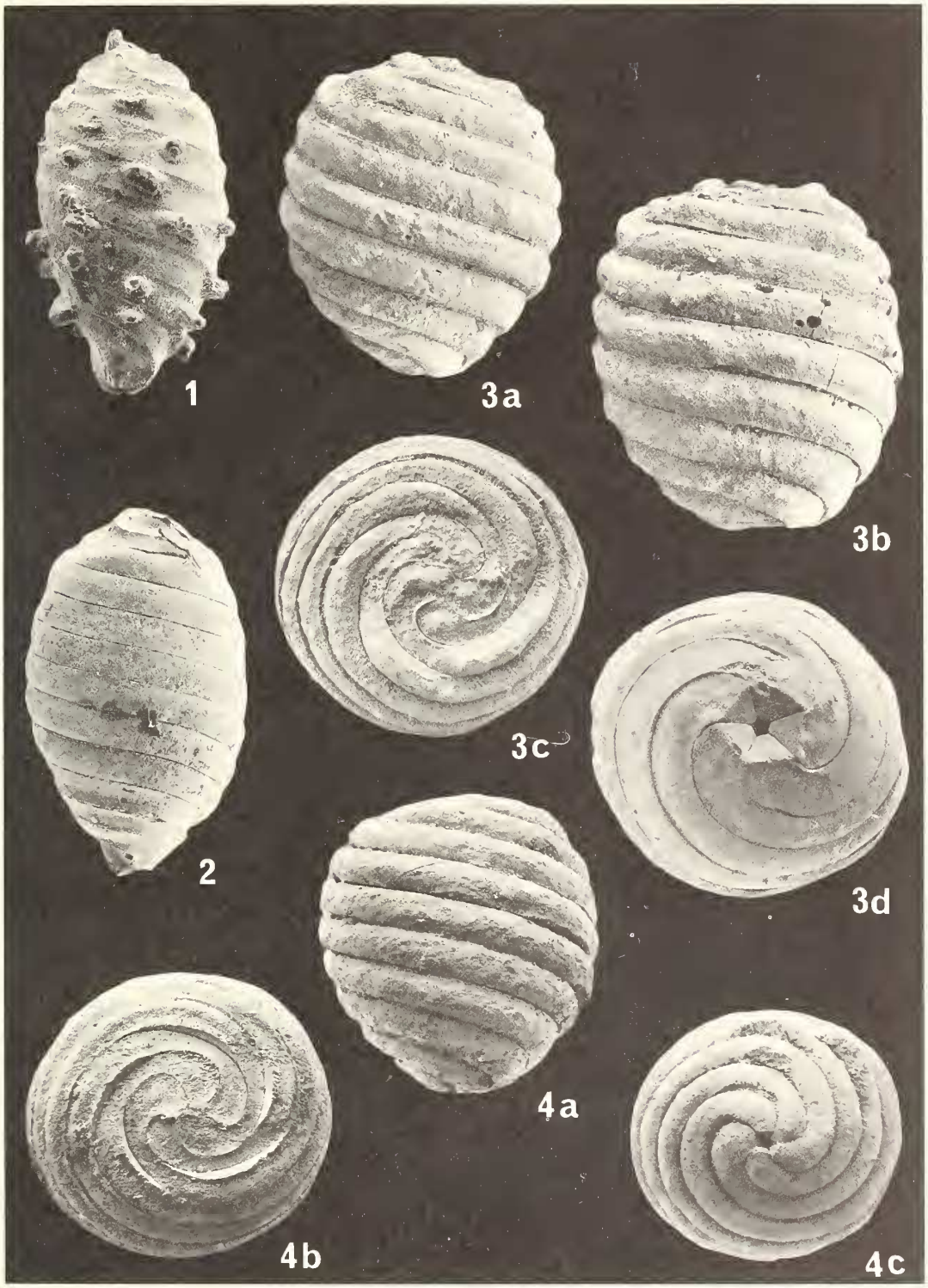
Harrisichara tuberculata (Lyell) Grambast, 1957

Plate 21, figs. 4, 5

1826 *Chara tuberculata* Lyell, p. 94, pl. 13, figs. 7, 8.
1828 *Chara tuberculosa*, Ad. Brongniart, p. 72.
1850 *Chara tuberculosa*, Unger, p. 33.

EXPLANATION OF PLATE 22

Fig. 1. *Chara antennata* Grambast, lateral view, ×110; from Upper Headon Beds, Headon Hill.
Fig. 2. *Grambastichara tornata* (Reid and Groves) Horn af Rantzien, lateral view, ×70; from Middle Headon Beds, Headon Hill.
Fig. 3. *Nitellopsis* (*Tectochara*) *latispira* n. sp., ×35; 3*a*, paratype, lateral view; 3*b*, holotype, lateral view; 3*c*, paratype, apical view; 3*d*, paratype, basal view.
Fig. 4. *Nitellopsis* (*Tectochara*) aff. *aemula* Grambast, ×35; 4*a*, lateral view; 4*b*, apical view; 4*c*, basal view; from Osborne Beds, Cliff End.



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1920 *Chara archiaci* Watelet var. *tuberculata*, Dollfus and Fritel, p. 252.
1927 *Kosmogyra tuberculata*, Pia, p. 90.
1957 *Harrisichara tuberculata*, Grambast, pl. 6, figs. 1–3, 8–10.

Neotype (the type-material has not been located). Specimen no. C.F. 1585b-1, Université des Sciences et Techniques, Montpellier, France. It is figured here (Pl. 21, fig. 5).

Locality. Whitecliff Bay, Isle of Wight; marls in lower part of Bembridge Limestone.

H. tuberculata is abundant from the base of the Bembridge Beds upwards (Horestone Point, Whitecliff Bay) and extends into the Lower Hamstead Beds. It is a sure indicator of the Lower (but not lowermost) Oligocene and of the base of the Middle Oligocene.

Morphologically it is characterized by its broad ellipsoidal shape, its well-defined but short basal stalk, and by its dimensions. The variability of the ornamentation is another feature of the species; the tubercles are either connected by a thin median line, or merged into a nodular ridge which may or may not extend to the apex. More rarely, isolated tubercles, separated from one another by one or two smaller tubercles, may be observed.

Harrisichara vasiformis-tuberculata

Plate 21, figs. 2, 3

Harrisichara vasiformis and *H. tuberculata* are two distinct and easily recognizable species. However, in Hampshire, from the Lower Headon Beds upwards and mainly in the series occurring between these and the Bembridge Beds, specimens of *Harrisichara* are found which are morphologically intermediate between these two species.

Table 2 summarizes the features peculiar to each population.

The forms intermediate between *H. vasiformis* and *H. tuberculata* are not restricted to Hampshire; they are also found in the Lowermost Oligocene in southern France (Triat and Truc 1972; Feist-Castel 1975). Due to their wide geographical distribution and short vertical extension, they are of real stratigraphic value.

Genus PSILOCHARA Grambast, 1959

Psilochara bitruncata (Reid and Groves) Feist-Castel, 1971

1921 *Chara strobilocarpa* var. *bitruncata* Reid and Groves, p. 188, pl. 5, fig. 13.
1959 *Charites bitruncata*, Horn af Rantzien, p. 67, pl. 3, figs. 1–4.
1971 *Psilochara bitruncata*, Feist-Castel, p. 166.

Lectotype. Specimen no. V 24122, British Museum (Natural History), London, designated here from the type material figured by Reid and Groves (1921).

Description. Gyrogonite elongated, apex truncated, base narrowed. Spiral cells concave to flat, smooth. Apical ends of the cells pointing upwards; junction line very short.

Dimensions. 800–900 μm long, 660–760 μm broad. Spiral cells 110–120 μm wide, showing 7–8 convolutions.

Distribution. *P. bitruncata*, whose type-locality is at Hordle, occurs infrequently in the Lower Headon Beds at Headon Hill. Besides Hampshire, it has been reported from the Upper Bartonian of southern France.

TABLE 2. Comparison of *Harrisichara* from the Lower Headon to Hamstead Beds, Isle of Wight.

	H. vasiformis	*H. vasif.-tubercul.*	*H. tuberculata*
General shape	long, ovoid tapering base	ovoid to ellipsoid	wide ellipsoid
Dimensions			
lengths	720-950 μm	680-920 μm	820-1160 μm
widths	500-760 μm	600-760 μm	760-1000 μm
cell widths	60-100 μm	50-90 μm	100-125 μm
Ornamentation	often isolated tubercles, separated by smaller ones	tubercles often connected by a median line	tubercles connected by a median line or merged, forming a nodular ridge
Stratigraphic distribution	Lower Headon Beds	Lower & Upper, Headon Beds, Osborne Beds	Bembridge & Hamstead Beds

Closely related forms. In the Upper Headon Beds at Headon Hill and Cliff End, as well as in the Osborne Beds at Cliff End, *Psilochara* is very abundant and appears to be similar to *P. bitruncata*, without being definitely assignable to it. In these populations, three different forms are distinguishable:

1. Specimens similar to *P. bitruncata* in having an elongated shape, usually with concave cells but with their dimensions slightly greater.
2. Specimens of the same shape and dimensions as the former, but with convex cells (Pl. 21, fig. 6) recalling *P. conspicua* Grambast.
3. Specimens of ovoid shape, with flat or convex (rarely concave) cells, also characterized by a clear apical zone of large diameter (480–580 μm) and by wavy sutures in the lower region of the gyrogonites. Apart from its longer shape, this form is very similar to *P. repanda* Grambast.

Psilochara polita (Reid and Groves) Grambast, 1959

1921 *Chara polita* Reid and Groves, p. 187, pl. 5, figs. 9, 12.
1927 *Gyrogonites politus*, Pia, p. 90.
1959 *Peckichara polita*, Horn af Rantzien, p. 116, pl. 13, figs. 1–3.
1959 *Psilochara polita*, Grambast, p. 11.

Lectotype. Reid and Groves 1921, pl. 5, fig. 12; designated by Grambast 1958, p. 179. Slide 76521, Geological Survey, London.

P. polita, which is associated with *P. bitruncata* in the Lower Headon Beds at

Headon Hill, differs from the latter by its ovoid shape, its dimensions (680–880 μm × 600–720 μm), the number of convolutions (8–10), and the undulations of the sutures.

Genus STEPHANOCHARA Grambast, 1959
Stephanochara edwardsi Grambast, 1958, p. 168

Holotype. Specimen no. 9-6-19, British Museum (Natural History), London.

This species is abundant in the Lower Headon Beds at Headon Hill, but was not found in younger beds. From a morphological point of view, *S. edwardsi* is very close to *S. grambasti* Feist-Castel, a species of nearly the same age from southern France. The latter is, however, easily distinguishable by its narrower basal region and the less well-marked, or even non-existent, periapical constrictions.

Genus RHABDOCHARA Mädler, 1955 emend. Grambast, 1962
Rhabdochara stockmansi Grambast, 1957

Holotype. Specimen no. C. 140-1, Grambast Collection, Université des Sciences et Techniques, Montpellier, France.

R. stockmansi occurs infrequently in the Bembridge Beds at Horestone Point and at Whitecliff Bay. This species, which extends into the Lower Hamstead Beds, is common in other regions of Europe particularly at the base of the Middle Oligocene (e.g. Hoogbutsel, Belgium; Ronzon, France).

Genus GRAMBASTICHARA Horn af Rantzien, 1959
Grambastichara tornata (Reid and Groves) Horn af Rantzien, 1959

Plate 22, fig. 2

1921 *Chara tornata* Reid and Groves, p. 187, pl. 5, figs. 1–3.
1927 *Gyrogonites tornatus*, Pia, p. 90.
non Tectochara tornata, Mädler, 1955, p. 296, taf. 26, figs. 19–22.
1959 *Grambastichara tornata*, Horn af Rantzien, p. 70, pl. 4, figs. 1–6.

Holotype. None designated.

Lectotype. Reid and Groves 1921, pl. 5, fig. 3 (designation by Mädler 1955). Specimen no. 16519, Geological Survey, London.

Although the type-locality is the equivalent of that at Hordle, *C. tornata* was not found in the Lower Headon Beds of the Isle of Wight (from which I collected only very little material). This species is abundant in the Middle Headon *Neritina* Beds, at Headon Hill. The specimens are very similar to those described by Reid and Groves; only the dimensions are slightly different, the upper and lower limits of variation of length and width being 100 μm greater.

In both localities, the apical rosette which characterizes the genus of Horn af Rantzien is not in every case obvious in *G. tornata*, its type-species. On the contrary, nearly half of the specimens present a pattern quite similar to that of *Chara*. It differs from *Chara* only in the cellular relief, concave in the latter, convex or flat in *G. tornata*. It is thus obvious that the separation of *Grambastichara* from *Chara* remains problematical, a question already raised by Grambast (1962).

Chara antennata Grambast, 1958

Plate 22, fig. 1

1958 *Chara antennata*, Grambast, p. 188.

Holotype. Specimen no. C. 244-6, Grambast Collection, Université des Sciences et Techniques, Montpellier, France.

Description. General shape cylindrical, apex convex, base tapering. Spiral cells flat to slightly concave, ornamented with very prominent cylindrical tubercles. Apical ends of the cells concave. Basal pore pentagonal, without a peripheric funnel.

Dimensions. 450–620 μm long, 350–400 μm wide, 8–11 convolutions.

Distribution. In the Isle of Wight, *C. antennata* occurs in the Upper Headon Beds and, very rarely, in the Middle Headon Beds. Besides these localities, it has been reported from 'Marnes à Pholadomyes' (Upper Bartonian) of the Paris basin by Grambast (1958) and Riveline (1973), and also from a locality of the Alès basin by the author (1971).

STRATIGRAPHIC IMPLICATIONS OF THE CHAROPHYTE DISTRIBUTION

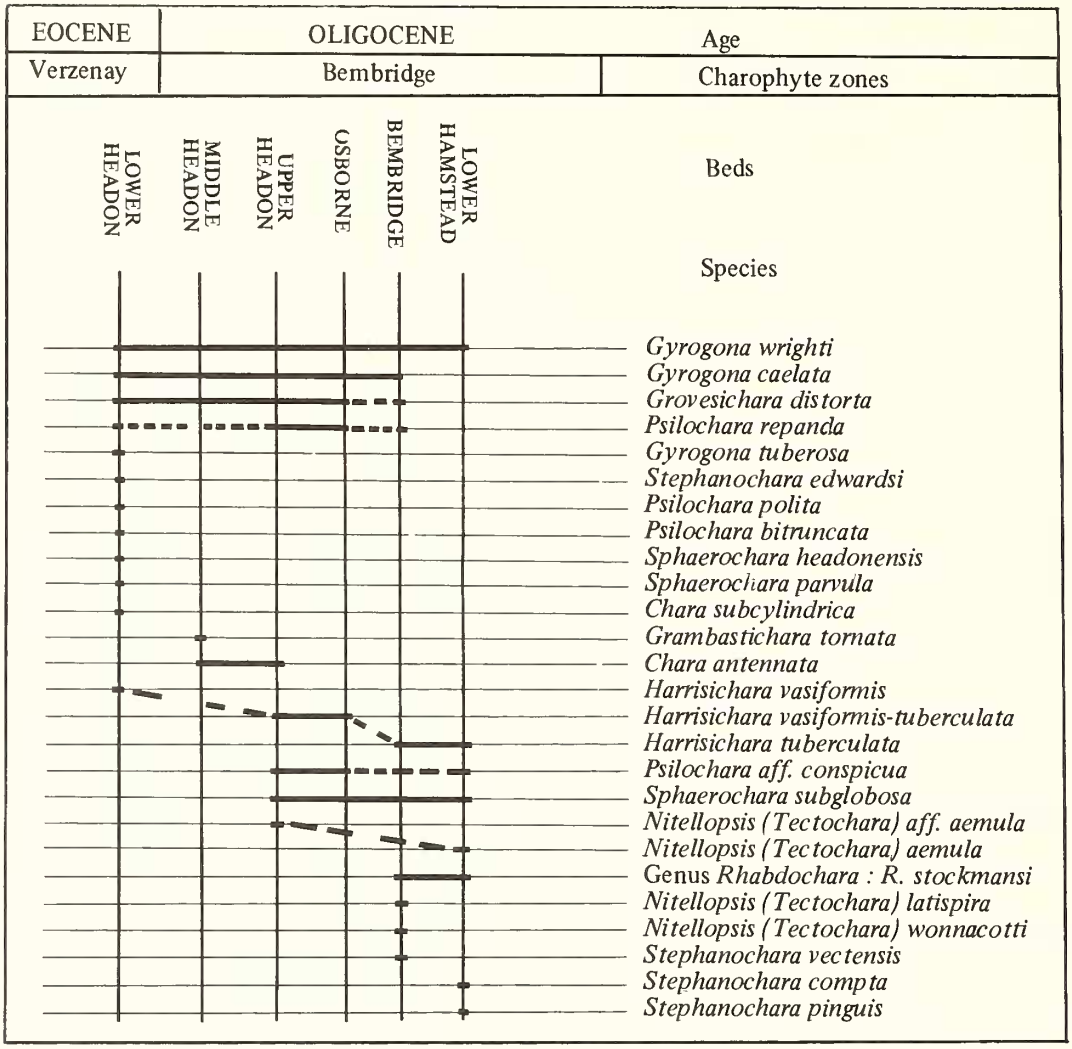
In Table 3, the above data are added to those from Reid and Groves (1921), Groves (1926), and Grambast (1958, summarized by Curry 1966), concerning the floras of the Lower Headon (Hordle), Bembridge, and Hamstead Beds.

This study revealed the floras, which were previously unknown, in the levels between the Lower Headon and the Bembridge Beds. From the established succession, one can see that the change in the floras from the Verzenay (Hordle) Zone to the Bembridge Zone is progressive, whereas the transition previously appeared to be more abrupt.

Concerning the position of the presently controversial Eocene–Oligocene boundary, charophytes provide no decisive information, since the stratigraphic divisions are essentially based upon marine faunas. We have, therefore, indicated only the divisions which seem most consistent with their distribution.

In the Palaeogene of the Isle of Wight and of Hampshire in general, the most obvious floristic changes occur at two levels. First, in the Upper Headon Beds where, after the disappearance of numerous species from the Lower Headon Beds, there appears *Sphaerochara subglobosa* which extends into the Lower Hamstead Beds. Although the floras of the Lower and Upper Headon Beds remain quite distinct (those of the Middle Headon Beds being of no stratigraphic value), it cannot be called a real renewal, since several Bartonian species extend into the Upper Headon Beds, and since transitional forms are observed there as well. The second change occurs at the level of the Bembridge Beds, where there appears typical *H. tuberculata* as well as the genus *Rhabdochara*, represented by *R. stockmansi*. Here the break appears more distinct than previously; however, in other regions (notably the south of France), the transitional flora, which in the Isle of Wight figures only in the Upper Headon and Osborne Beds, may extend into levels equivalent to the Bembridge Beds (work on this subject is now in progress). It is thus noted that the distribution of the charophytes would not usually lend itself to a break at this level. Likewise, the floristic composition does not vary noticeably between the Bembridge and Lower

TABLE 3. Vertical extension of Charophyte floras in the Upper Eocene and Lower Oligocene of Hampshire.



Hamstead Beds; although they may be distinguished by the presence of characteristic species, these two levels do in fact have a number of species in common: *H. tuberculata*, *R. stockmansi*, *S. subglobosa*, and *G. wrighti*.

The position of the Eocene–Oligocene boundary which best agrees with the charophyte distribution is thus the one presently accepted by the Stratigraphical Lexicon (Denizot 1957; Curry 1958).

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